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Wake topology of under-actuated rajiform batoid robots PABLO VALDIVIA Y ALVARADO, GABRIEL WEYMOUTH, DILIP THEKOODAN, Singapore-MIT Alliance for Research and Technology, NICHOLAS PATRIKALAKIS, Massachusetts Institute of Technology — Under-actuated continuous soft robots are designed to have modes of vibration that match desired body motions using minimal actuation. The desired modes of vibration are enabled by flexible continuous bodies with heterogenous material distributions. Errors or intentional approximations in the manufactured material distributions alter the achieved body motions and influence the resulting locomotion performance. An under-actuated continuous soft robot designed to mimic rajiform batoids such as stingrays is used to investigate the influence that fin kinematics variations have on wake topology, and the trade-offs that simplifying the body material structure has on achievable swimming performance. Pectoral fin kinematics in rajiform batoids are defined by traveling waves along the fin cord with particular amplitude envelopes along both the fin cord and span. Digital particle image velocimetry (DPIV) analysis of a prototype's wake structure and immersed-boundary numerical simulations are used to clarify the role of traveling wave wavelength, fin flapping frequency, and amplitude envelope characteristics on the resulting wake topology and swimming performance.

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